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(54) **Method and apparatus for detecting abnormality in a battery pack system**

Fehlererkennungsvorverfahren und -gerät in einem Batteriesatz system

Procédé et dispositif de détection d'anomalie dans un système de boîtier d'accumulateur

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Description

[0001] The present invention relates to a method and an apparatus for detecting an abnormality in a battery pack system. The battery pack system according to the preamble of claim 4 is composed of a plurality of battery pack blocks, each of which is constituted by connecting a plurality of cells in series, that are connected with one another by a combination of serial connection and parallel connection.

[0002] A conventional battery pack system according to the preamble of claim 4 typically incorporates a battery pack block constructed by connecting a plurality of cells in series. For example, six cells are connected together in series so as to provide a battery module, and 20 to 30 units of such battery modules are juxtaposed and connected together in series, whereupon the battery pack block is realized. In the battery pack system, the temperature, voltage, and current of the battery pack block are detected based on output signals from various sensors (not shown) mounted on the battery pack block. Based on the detection results, various control operations and abnormality detection are executed.

[0003] Moreover, in keeping with the demand for a higher-capacity, higher-power battery pack system, a battery pack system 100 as shown in Fig. 4 has been proposed that is composed of a plurality of the above-described battery pack blocks 11 connected with one another by a combination of serial connection and parallel connection. In such a battery pack system, a single current sensor 12 is typically disposed in a region where total current flows.

[0004] However, the battery pack system shown in Fig. 4 poses the following problem. When an abnormality occurs, e.g., when a rise in battery resistance occurs in the cell incorporated into any of the battery pack blocks 11, the result appears only partly in the current sensor 12. This makes accurate abnormality detection difficult. Even if the abnormality can be detected, it is impossible to immediately determine which one of the battery pack blocks 11 suffers from the abnormality. Thus, appropriate measures cannot be readily taken.

[0005] In EP 0 982 830 A2 a battery pack is disclosed comprising a plurality of cells connected in parallel or in series together. The known battery pack further comprises means for detecting a charging current in the whole battery pack and means for detecting a charging current in each of the cells. By comparing the charging current values for each of the cells with a predetermined reference value it is judged whether the cells are normal or faulty. A reference value is a product of a judging current value from the total judging current value. In another embodiment of the known battery pack individual voltages of the cells and the total voltage of the battery pack are measured. These individual cell voltage values are compared with a reference voltage value to judge whether each of the cells is normal or faulty.

[0006] The present invention has been devised in light

of the above-mentioned problems of the conventional art, and accordingly an object of the present invention is to provide a method and an apparatus for detecting an abnormality in a battery pack system. The method and apparatus should also be capable, when an abnormality occurs in any of battery pack blocks constituting a battery pack system, of identifying the abnormal battery pack block.

[0007] To achieve the above object, according to one aspect of the present invention, there is provided a method for detecting an abnormality in a battery pack system comprising the features of claim 1. With this method, an abnormal battery pack block can be identified, depending on the algorithm.

[0008] According to an exemplary embodiment of the invention, in a battery pack system composed of a plurality of battery pack block groups connected in parallel, each of which is constituted by connecting in series a plurality of battery pack blocks, when a current value difference among the battery pack block groups in a parallel configuration exceeds a predetermined threshold value, it is judged that an abnormality occurs in the battery pack block or in a current detecting member. On the other hand, when a current value difference among the battery pack blocks connected in series exceeds a predetermined threshold value, it is judged that an abnormality occurs in the current detecting member. Based on the judgment, it is possible to make a distinction between a battery pack block abnormality and a current detecting member abnormality.

[0009] In a battery pack system composed of a plurality of battery pack block groups connected in series, each of which is constituted by connecting in parallel a plurality of battery pack blocks, when a current value difference among the battery pack blocks in a parallel configuration exceeds a predetermined threshold value, it is judged that an abnormality occurs in the battery pack block or in the current detecting member. On the other hand, when a current value difference among the battery pack block groups in a serial configuration exceeds a predetermined threshold value, it is judged that an abnormality occurs in the battery pack block or in the current detecting member. Moreover, among the battery pack block groups, comparison is made as to the sum of current values in the battery pack blocks connected in parallel. Then, when a difference in the sum of battery pack block's current values among the battery pack block groups exceeds a predetermined threshold value, it is judged that an abnormality occurs in the current detecting member. Based on the judgment, it is possible to make a distinction between a battery pack block abnormality and a current detecting member abnormality.

[0010] According to another aspect of the invention, there is provided an apparatus for detecting an abnormality in a battery pack system, comprising the features of claim 4.

[0011] Preferred embodiments of the present invention will be hereinafter described with reference to the

accompanying drawings, in which:

Fig. 1 is a block diagram schematically showing the structure of a battery pack system according to one embodiment of the present invention;

Figs. 2A and 2B are explanatory diagrams of the workings of the embodiment, with Fig. 2A showing the configuration of a current sensor, and Fig. 2B showing a flow chart of algorithms for use in abnormality detection;

Figs. 3A and 3B are explanatory diagrams of the workings of another embodiment of the invention, with Fig. 3A showing the configuration of a current sensor, and Fig. 3B showing a flow chart of algorithms for use in abnormality detection; and

Fig. 4 is a block diagram schematically showing the structure of a conventional battery pack system.

[0012] Hereinafter, with reference to Figs. 1 through 2B, a description will be given as to one embodiment of the method and apparatus for detecting an abnormality in a battery pack system according to the present invention.

[0013] In Fig. 1, reference numeral 10 represents a battery pack system. The battery pack system 10 includes four battery pack blocks 1a to 1d, each of which is constituted by connecting a plurality of cells in series. The battery pack blocks 1a and 1c, as well as 1b and 1d, are connected in series, thereby constituting two battery pack block groups. These battery pack block groups are connected in parallel, whereupon the battery pack system 10 is realized. The battery pack blocks 1a to 1d are each constructed as follows. For example, six cells are connected together in series so as to provide a battery module, and 20 to 30 units of such battery modules are disposed in parallel and connected in series. The battery pack blocks 1a to 1d are provided with cooling fans 2a to 2d, respectively, for cooling purposes.

[0014] In correspondence with the battery pack blocks 1a to 1d, there are provided temperature/voltage detecting sections 3a to 3d for detecting the temperature and voltage of each of the battery pack blocks 1a to 1d, based on output signals from a sensor (not shown) attached to each battery pack block. Detection results provided by the temperature/voltage detecting sections 3a to 3d are inputted to a control section 5. Moreover, the battery pack blocks 1a to 1d are provided with current sensors 4a to 4d, respectively, for detecting currents flowing there-through. Detection results provided by the current sensors 4a to 4d are also inputted to the control section 5.

[0015] The control section 5 is designed to control the operation of each of the cooling fans 2a to 2d, in accordance with the detection results provided by the temperature/voltage detecting sections 3a to 3d and the current sensors 4a to 4d. The control section 5 also serves to detect abnormalities occurring in the battery pack blocks 1a to 1d. Reference symbols 6a and 6b each represent an output terminal of the battery pack system 10.

[0016] Next, with reference to Figs. 2A and 2B, a description will be given as to abnormality detection operations that are performed in the battery pack blocks 1a to 1d under the control of the control section 5.

[0017] In Fig. 2A, taken up as an explanatory example is a combination of the battery pack blocks 1a, 1b, and 1c, and their current sensors 4a, 4b, and 4c. Here, the currents detected by the current sensors 4a, 4b, and 4c are assumed to be I_1 , I_2 , and I_3 , respectively.

[0018] Abnormality detection algorithms adopted in that case will be described below with reference to a flow chart shown in Fig. 2B. Firstly, the currents I_1 , I_2 , and I_3 detected by the current sensors 4a, 4b, and 4c are read out. Then, whether or not a value $(I_1 - I_2)$ exceeds a predetermined threshold value t_1 is determined. In normal cases, there is little difference between I_1 and I_2 . Consequently, in a case where $(I_1 - I_2) > t_1$, it is judged that a battery abnormality occurs in the battery pack block 1a or 1b, or that an abnormality occurs in the current sensor 4a or 4b. Subsequently, whether or not a value $(I_1 - I_3)$ exceeds a predetermined threshold value t_2 is determined. In normal cases, values I_1 and I_3 are identical. Consequently, in a case where $(I_1 - I_3) > t_2$, it is judged that an abnormality occurs in any or both of the current sensors 4a and 4c.

[0019] Thus, in cases where $(I_1 - I_2) < t_1$ and $(I_1 - I_3) < t_2$, it is judged that no abnormality takes place. Moreover, in terms of $(I_1 - I_3) > t_2$, in a case where $(I_1 - I_2) > t_1$ in spite of the fact that the current sensor 4a is kept in a normal state, it is judged that an abnormality occurs in the battery pack block 1a or in the current sensor 4b.

[0020] Likewise, a combination of the current sensors 4a, 4b, and 4d, that of the current sensors 4a, 4c, and 4d, and that of the current sensors 4b, 4c, and 4d are each subjected to the algorithm-based judgment. Eventually, it is possible to determine which one of the battery pack blocks 1a to 1d, or which one of the current sensors 4a, 4b, 4c, and 4d suffers from an abnormality. Note that, in some cases, proper determination can be made without performing the algorithm-based judgment on a combination-by-combination basis. Proper determination can also be made by examining the actual value of the current value I .

[0021] Next, with reference to Figs. 3A and 3B, a description will be given as to abnormality detection operations that are performed in the battery pack blocks 1a to 1d constituting the battery pack system 10 according to another embodiment of the invention.

[0022] The battery pack system 10 of this embodiment is constructed as follows. As shown in Fig. 3A, the battery pack blocks 1a and 1b, as well as 1c and 1d, are connected in parallel, thereby constituting two battery pack block groups. These battery pack block groups are connected in series. Here, the currents detected by the current sensors 4a, 4b, 4c, and 4d of the battery pack blocks 1a to 1d are assumed to be I_1 , I_2 , I_3 , and I_4 , respectively.

[0023] Abnormality detection algorithms adopted in that case will be described below with reference to a flow

chart shown in Fig. 3B. Firstly, the currents I_1 , I_2 , I_3 , and I_4 detected by the current sensors 4a, 4b, 4c, and 4d are read out. Then, whether or not a value $(I_1 - I_2)$ exceeds a predetermined threshold value t_1 is determined. In normal cases, there is little difference between I_1 and I_2 . Consequently, in a case where $(I_1 - I_2) > t_1$, it is judged that a battery abnormality occurs in the battery pack block 1a or 1b, or that an abnormality occurs in the current sensor 4a or 4b. Subsequently, whether or not a value $(I_1 - I_3)$ exceeds the predetermined threshold value t_1 is determined. In normal cases, there is little difference between I_1 and I_3 . Consequently, in a case where $(I_1 - I_3) > t_1$, it is judged that a battery abnormality occurs in the battery pack block 1a or 1c, or that an abnormality occurs in the current sensor 4a or 4c, provided that the battery pack blocks 1b and 1d are each kept in a normal state. Thereafter, whether or not a value $(I_1 + I_2) - (I_3 + I_4)$ exceeds a predetermined threshold value t_2 is determined. In normal cases, values $(I_1 + I_2)$ and $(I_3 + I_4)$ are identical. Consequently, in a case where $(I_1 + I_2) - (I_3 + I_4) > t_2$, it is judged that an abnormality occurs in any of the current sensors 4a to 4d.

[0024] Thus, in cases where $(I_1 - I_2) < t_1$, $(I_1 - I_3) < t_1$, and $(I_1 + I_2) - (I_3 + I_4) < t_2$, it is judged that no abnormality takes place.

[0025] Moreover, in terms of $(I_1 + I_2) - (I_3 + I_4) > t_2$, in cases where $(I_1 - I_2) > t_1$, and $(I_1 - I_3) > t_1$ in spite of the fact that the current sensors 4a to 4d are each kept in a normal state, it is judged that an abnormality occurs in the battery pack block 1a. On the other hand, in cases where $(I_1 - I_2) > t_1$, and $(I_1 - I_3) < t_1$, it is judged that an abnormality occurs in the battery pack block 1b.

[0026] Likewise, a judgment on whether or not $(I_2 - I_1) > t_1$ and $(I_2 - I_4) > t_1$, a judgment on whether or not $(I_3 - I_4) > t_1$ and $(I_3 - I_1) > t_1$, and a judgment on whether or not $(I_4 - I_3) > t_1$ and $(I_4 - I_2) > t_1$ are made successively. Then, by examining combinations of the judgment results, it is possible to determine which one of the battery pack blocks suffers from an abnormality.

[0027] As described heretofore, according to the method and apparatus for detecting an abnormality in a battery pack system embodying the present invention, the current value of each of the battery pack blocks is detected, and, based on the detected current values, the abnormality of the battery pack block is detected by using an algorithm constructed in accordance with the connection status of the battery pack blocks. Hence, an abnormal battery pack block is identified successfully by current detection.

Claims

1. A method for detecting an abnormality in a battery pack system (10), the battery pack system (10) being composed of a plurality of battery pack blocks (1a, 1b, 1c, 1d), connected with one another by a combination of serial connection and parallel connection,

each of the battery pack blocks (1a, 1b, 1c, 1d) being constituted by a plurality of cells connected in series, the method comprising:

- detecting a current value (I_1 , I_2 , I_3 , I_4) of each of the battery pack blocks (1a, 1b, 1c, 1d),

characterized by:

- detecting an abnormality occurring in one of the battery pack blocks (1a, 1b, 1c, 1d) based on current value differences or differences between sums of the detected current values (I_1 , I_2 , I_3 , I_4) of each of the battery pack blocks (1a, 1b, 1c, 1d), by using an algorithm constructed in accordance with the present combination of serial connection and parallel connection of the plurality of battery pack blocks (1a, 1b, 1c, 1d).

2. The method for detecting an abnormality in a battery pack system (10) according to claim 1, wherein:

- a plurality of battery pack block groups is connected in parallel, each of the battery pack block groups being constituted by a plurality of battery pack blocks (1a, 1b, 1c, 1d) connected in series, and each of the battery pack blocks (1a, 1c; 1b, 1d) comprise a current detecting member (4a, 4b, 4c, 4d),

- when a current value difference among the battery pack block groups (1a, 1c; 1b, 1d) connected in parallel exceeds a predetermined first threshold value (t_1), judging that an abnormality occurs in one of the battery pack blocks (1a, 1b, 1c, 1d) or in a current detecting member (4a, 4b, 4c, 4d), and,

- when a current value difference among the battery pack blocks (1a, 1b, 1c, 1d) connected in series exceeds a predetermined second threshold value (t_2), judging that an abnormality occurs in one of the current detecting members (4a, 4b, 4c, 4d),

- based on the judgment results, determination is made as to the abnormality of the battery pack blocks (1a, 1b, 1c, 1d).

3. The method for detecting an abnormality in a battery pack system (10) according to claim 1, wherein:

- a plurality of battery pack block groups is connected in series, each of the battery pack block groups being constituted by a plurality of battery pack blocks (1a, 1b, 1c, 1d) connected in parallel, and each of the battery pack blocks (1a, 1b; 1c, 1d) comprise a current detecting member (4a, 4b, 4c, 4d),

- when a current value difference among the battery pack blocks (1a, 1b, 1c, 1d) connected in

- parallel exceeds a predetermined first threshold value (t_1), judging that an abnormality occurs in one the battery pack blocks (1a, 1b, 1c, 1d) or in one of the current detecting members (4a, 4b, 4c, 4d), and,
- when a current value difference among the battery pack block groups (1a, 1b; 1c, 1d) connected in series exceeds the first threshold value (t_1), judging that an abnormality occurs in one of the battery pack blocks (1a, 1b, 1c, 1d) or in one of the current detecting member (4a, 4b, 4c, 4d),
 - among the battery pack block groups, comparing the sum of current values (I_1, I_2, I_3, I_4) in the battery pack blocks (1a, 1b, 1c, 1d) connected in parallel, and, when a difference in the sum of battery pack block's current values (I_1, I_2, I_3, I_4) among the battery pack block groups exceeds a predetermined second threshold value (t_2), it is judged that an abnormality occurs in one of the current detecting member (4a, 4b, 4c, 4d), and
 - based on the judgment results, determination is made as to the abnormality of the battery pack blocks (1a, 1b, 1c, 1d).
4. An apparatus for detecting an abnormality in a battery pack system (10), the battery pack system being composed of:
- a plurality of battery pack blocks (1a, 1b, 1c, 1d) connected with one another by a combination of serial connection and parallel connection, each of the battery pack blocks (1a, 1b, 1c, 1d) being constituted by connecting a plurality of cells in series,
 - a current detecting member (4a, 4b, 4c, 4d) disposed in each of the battery pack blocks (1a, 1b, 1c, 1d), for detecting a current value (I_1, I_2, I_3, I_4) of the respective battery pack block (1a, 1b, 1c, 1d),
- characterized in that** the apparatus comprises:
- a control section (5) for detecting an abnormality of one of the battery pack blocks (1a, 1b, 1c, 1d) based on current value differences or differences between sums of the detected current values (I_1, I_2, I_3, I_4) detected by the current detecting members (4a, 4b, 4c, 4d), by using an algorithm constructed in accordance with the present combination of serial and parallel connection of the plurality of battery pack blocks (1a, 1b, 1c, 1d).
5. The apparatus for detecting an abnormality in a battery pack system (10) according to claim 4, wherein a plurality of battery pack block groups is connected in parallel, each of the battery pack block groups being constituted by a plurality of battery pack blocks

(1a, 1b, 1c, 1d) connected in series .

6. The apparatus for detecting an abnormality in a battery pack system (10) according to claim 5, wherein the control section (5) is adapted and constructed to perform the method according to claim 2.
7. The apparatus for detecting an abnormality in a battery pack system (10) according to claim 4, wherein a plurality of battery pack block groups is connected in series, each of the battery pack block groups 1a, 1b; 1c, 1d being constituted by a plurality of battery pack blocks (1a, 1b, 1c, 1d) connected in parallel .
8. The apparatus for detecting an abnormality in a battery pack system (10) according to claim 7, wherein the control section (5) is adapted and constructed to perform the method according to claim 3.

Patentansprüche

1. Verfahren zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10), wobei sich das Batteriesatzsystem (10) aus mehreren miteinander durch eine Kombination von Reihenschaltung und Parallelschaltung verbundenen Batteriesatzblöcken (1a, 1b, 1c, 1d) zusammensetzt, wobei jeder Batteriesatzblock (1a, 1b, 1c, 1d) aus mehreren in Reihe geschalteten Zellen gebildet ist, wobei das Verfahren enthält:

- Ermitteln eines Stromwertes (I_1, I_2, I_3, I_4) jedes Batteriesatzblocks (1a, 1b, 1c, 1d), **gekennzeichnet durch:**

- Ermitteln einer in einem der Batteriesatzblöcke (1a, 1b, 1c, 1d) vorliegenden Auffälligkeit anhand von Stromwertdifferenzen oder Differenzen zwischen Summen der ermittelten Stromwerte (I_1, I_2, I_3, I_4) jedes Batteriesatzblocks (1a, 1b, 1c, 1d) unter Verwendung eines Algorithmus, der in Übereinstimmung mit der vorliegenden Kombination von Reihenschaltung und Parallelschaltung der mehreren Batteriesatzblöcke (1a, 1b, 1c, 1d) erstellt wird.

2. Verfahren zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10) nach Anspruch 1, wobei:

- mehrere Batteriesatzblockgruppen parallel geschaltet sind, wobei jede Batteriesatzblockgruppe aus mehreren in Reihe geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) gebildet ist und jeder Batteriesatzblock (1a, 1c; 1b, 1d) ein Stromerfassungselement (4a, 4b, 4c, 4d) aufweist,
- Beurteilen, ob eine Auffälligkeit in einem der Batteriesatzblöcke (1a, 1b, 1c, 1d) oder in einem Stromerfassungselement (4a, 4b, 4c, 4d) vor-

- liegt, wenn eine Stromwertdifferenz zwischen den parallel geschalteten Batteriesatzblockgruppen (1a, 1c; 1b, 1d) einen vorgegebenen ersten Schwellenwert (t_1) überschreitet, und
- Beurteilen, ob eine Auffälligkeit in einem der Stromerfassungselemente (4a, 4b, 4c, 4d) vorliegt, wenn eine Stromwertdifferenz zwischen den in Reihe geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) einen vorgegebenen zweiten Schwellenwert (t_2) überschreitet,
 - eine Bestimmung der Auffälligkeit in den Batteriesatzblöcken (1a, 1b, 1c, 1d) anhand der Beurteilungsergebnisse erfolgt.
3. Verfahren zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10) nach Anspruch 1, wobei:
- mehrere Batteriesatzblockgruppen in Reihe geschaltet sind, wobei jede Batteriesatzblockgruppe von mehreren parallel geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) gebildet ist und jeder Batteriesatzblock (1a, 1b; 1c, 1d) ein Stromerfassungselement (4a, 4b, 4c, 4d) enthält,
 - Beurteilen, ob eine Auffälligkeit in einem der Batteriesatzblöcke (1a, 1b, 1c, 1d) oder in einem der Stromerfassungselemente (4a, 4b, 4c, 4d) vorliegt, wenn eine Stromwertdifferenz zwischen den parallel geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) einen vorgegebenen ersten Schwellenwert (t_1) überschreitet, und
 - Beurteilen, ob eine Auffälligkeit in einem der Batteriesatzblöcke (1a, 1b, 1c, 1d) oder in einem der Stromerfassungselemente (4a, 4b, 4c, 4d) vorliegt, wenn eine Stromwertdifferenz zwischen den in Reihe geschalteten Batteriesatzblockgruppen (1a, 1b; 1c, 1d) den ersten Schwellenwert (t_1) überschreitet,
 - Vergleichen der Stromwertsummen (I_1, I_2, I_3, I_4) in den parallel geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) zwischen den Batteriesatzblockgruppen und Beurteilen, ob eine Auffälligkeit in einem der Stromerfassungselemente (4a, 4b, 4c, 4d) vorliegt, wenn eine Differenz in den Stromwertsummen (I_1, I_2, I_3, I_4) der Batteriesatzblöcke zwischen den Batteriesatzblockgruppen einen vorgegebenen zweiten Schwellenwert (t_2) überschreitet, und
 - eine Bestimmung der Auffälligkeit in den Batteriesatzblöcken (1a, 1b, 1c, 1d) anhand der Beurteilungsergebnisse erfolgt.
4. Vorrichtung zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10), wobei sich das Batteriesatzsystem zusammensetzt aus:
- mehreren miteinander durch eine Kombination von Reihenschaltung und Parallelschaltung verbundener Batteriesatzblöcke (1a, 1b, 1c, 1d),
- wobei jeder Batteriesatzblock (1a, 1b, 1c, 1d) durch mehrere in Reihe geschaltete Zellen gebildet ist,
- einem in jedem Batteriesatzblock (1a, 1b, 1c, 1d) angeordneten Stromerfassungselement (4a, 4b, 4c, 4d) zum Ermitteln eines Stromwertes (I_1, I_2, I_3, I_4) des entsprechenden Batteriesatzblocks (1a, 1b, 1c, 1d),
- dadurch gekennzeichnet, dass** die Vorrichtung enthält:
- einen Steuerbereich (5) zum Ermitteln einer Auffälligkeit in einem der Batteriesatzblöcke (1a, 1b, 1c, 1d) anhand von Stromwertdifferenzen oder Differenzen zwischen Summen der von den Stromerfassungselementen (4a, 4b, 4c, 4d) ermittelten Stromwerte (I_1, I_2, I_3, I_4) unter Verwendung eines Algorithmus, der in Übereinstimmung mit der vorliegenden Kombination von Reihenschaltung und Parallelschaltung der mehreren Batteriesatzblöcke (1a, 1b, 1c, 1d) erstellt wird.
5. Vorrichtung zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10) nach Anspruch 4, wobei mehrere Batteriesatzblockgruppen parallel geschaltet sind, wobei jede Batteriesatzblockgruppe aus mehreren in Reihe geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) gebildet ist.
6. Vorrichtung zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10) nach Anspruch 5, wobei der Steuerbereich (5) zum Durchführen des Verfahrens nach Anspruch 2 angepasst und ausgebildet ist.
7. Vorrichtung zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10) nach Anspruch 4, wobei mehrere Batteriesatzblockgruppen in Reihe geschaltet sind, wobei jede Batteriesatzblockgruppe aus mehreren parallel geschalteten Batteriesatzblöcken (1a, 1b, 1c, 1d) gebildet ist.
8. Vorrichtung zum Ermitteln einer Auffälligkeit in einem Batteriesatzsystem (10) nach Anspruch 7, wobei der Steuerbereich (5) zum Durchführen des Verfahrens nach Anspruch 3 angepasst und ausgebildet ist.

Revendications

1. Procédé de détection d'une anomalie dans un système de blocs de batteries (10), le système de blocs de batteries (10) étant composé d'une pluralité de blocs de batteries (1a, 1b, 1c, 1d), connectés l'un à l'autre par une combinaison de connexion en série

et de connexion en parallèle, chacun des blocs de batteries (1a, 1b, 1c, 1d) étant constitué d'une pluralité de cellules connectées en série, le procédé comprenant :

- la détection d'une valeur de courant (I_1, I_2, I_3, I_4) de chacun des blocs de batteries (1a, 1b, 1c, 1d),

caractérisé par :

- la détection d'une anomalie présente dans l'un des blocs de batteries (1a, 1b, 1c, 1d) sur la base de différences de valeurs de courant ou de différences entre sommes des valeurs de courant détectées (I_1, I_2, I_3, I_4) de chacun des blocs de batteries (1a, 1b, 1c, 1d), en utilisant un algorithme conçu selon la présente combinaison de connexion en série et de connexion en parallèle de la pluralité de blocs de batteries (1a, 1b, 1c, 1d).

2. Procédé de détection d'une anomalie dans un système de blocs de batteries (10) selon la revendication 1, dans lequel :

- une pluralité de groupes de blocs de batteries est connectée en parallèle, chacun des groupes de blocs de batteries étant constitué d'une pluralité de blocs de batteries (1a, 1b, 1c, 1d) connectés en série, et chacun des blocs de batteries (1a, 1c, 1b, 1d) comprend un élément de détection de courant (4a, 4b, 4c, 4d),
- lorsqu'une différence de valeur de courant parmi les groupes de blocs de batteries (1a, 1c, 1b, 1d) connectés en parallèle dépasse une première valeur seuil prédéterminée (t_1), on juge qu'une anomalie est présente dans l'un des blocs de batteries (1a, 1b, 1c, 1d) ou dans un élément de détection de courant (4a, 4b, 4c, 4d), et,
- lorsqu'une différence de valeur de courant parmi les blocs de batteries (1a, 1b, 1c, 1d) connectés en série dépasse une seconde valeur seuil prédéterminée (t_2), on juge qu'une anomalie est présente dans l'un des éléments de détection de courant (4a, 4b, 4c, 4d),
- sur la base des résultats des jugements, on procède à une détermination de l'anomalie des blocs de batteries (1a, 1b, 1c, 1d).

3. Procédé de détection d'une anomalie dans un système de blocs de batteries (10) selon la revendication 1, dans lequel :

- une pluralité de groupes de blocs de batteries est connectée en série, chacun des groupes de blocs de batteries étant constitué d'une pluralité

de blocs de batteries (1a, 1b, 1c, 1d) connectés en parallèle, et chacun des blocs de batteries (1a, 1c, 1b, 1d) comprend un élément de détection de courant (4a, 4b, 4c, 4d),

- lorsqu'une différence de valeur de courant parmi les blocs de batteries (1a, 1c, 1b, 1d) connectés en parallèle dépasse une première valeur seuil prédéterminée (t_1), on juge qu'une anomalie est présente dans l'un des blocs de batteries (1a, 1b, 1c, 1d) ou dans l'un des éléments de détection de courant (4a, 4b, 4c, 4d), et,
- lorsqu'une différence de valeur de courant parmi les groupes de blocs de batteries (1a, 1c, 1b, 1d) connectés en série dépasse la première valeur seuil (t_1), on juge qu'une anomalie est présente dans l'un des blocs de batteries (1a, 1c, 1b, 1d) ou dans l'un des éléments de détection de courant (4a, 4b, 4c, 4d), et,
- parmi les groupes de blocs de batteries, on compare la somme des valeurs de courant (I_1, I_2, I_3, I_4) dans les blocs de batteries (1a, 1c, 1b, 1d) connectés en parallèle et, lorsqu'une différence dans la somme des valeurs de courant des blocs de batteries (I_1, I_2, I_3, I_4) parmi les groupes de blocs de batteries dépasse une seconde valeur seuil prédéterminée (t_2), on juge qu'une anomalie est présente dans l'un des éléments de détection de courant (4a, 4b, 4c, 4d), et
- sur la base des résultats des jugements, on procède à une détermination de l'anomalie des blocs de batteries (1a, 1c, 1b, 1d).

4. Appareil de détection d'une anomalie dans un système de blocs de batteries (10), le système de blocs de batteries étant composé des éléments suivants :

- une pluralité de blocs de batteries (1a, 1c, 1b, 1d) connectés les uns aux autres par une combinaison de connexion en série et de connexion en parallèle, chacun des blocs de batteries (1a, 1c, 1b, 1d) étant constitué en connectant une pluralité de cellules en série,
- un élément de détection de courant (4a, 4b, 4c, 4d) disposé dans chacun des blocs de batteries (1a, 1c, 1b, 1d), pour la détection d'une valeur de courant (I_1, I_2, I_3, I_4) du bloc de batteries respectif (1a, 1c, 1b, 1d),

caractérisé en ce que l'appareil comprend :

- une section de commande (5) pour détecter une anomalie de l'un des blocs de batteries (1a, 1c, 1b, 1d) sur la base de différences de valeur de courant ou de différences entre les sommes des valeurs de courant (I_1, I_2, I_3, I_4) détectées par les éléments de détection de courant (4a, 4b, 4c, 4d), en utilisant un algorithme conçu selon la présente combinaison de connexion en

série et de connexion en parallèle de la pluralité de blocs de batteries (1a, 1c, 1b, 1d).

5. Appareil de détection d'une anomalie dans un système de blocs de batteries (10) selon la revendication 4, dans lequel une pluralité de groupes de blocs de batteries est connectée en parallèle, chacun des groupes de blocs de batteries étant constitué d'une pluralité de blocs de batteries (1a, 1c, 1b, 1d) connectés en série. 5
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6. Appareil de détection d'une anomalie dans un système de blocs de batteries (10) selon la revendication 5, dans lequel la section de commande (5) est adaptée et conçue pour effectuer le procédé selon la revendication 2. 15
7. Appareil de détection d'une anomalie dans un système de blocs de batteries (10) selon la revendication 4, dans lequel une pluralité de groupes de blocs de batteries est connectée en série, chacun des groupes de blocs de batteries étant constitué d'une pluralité de blocs de batteries (1a, 1c, 1b, 1d) connectés en série. 20
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8. Appareil de détection d'une anomalie dans un système de blocs de batteries (10) selon la revendication 7, dans lequel la section de commande (5) est adaptée et conçue pour effectuer le procédé selon la revendication 3. 30

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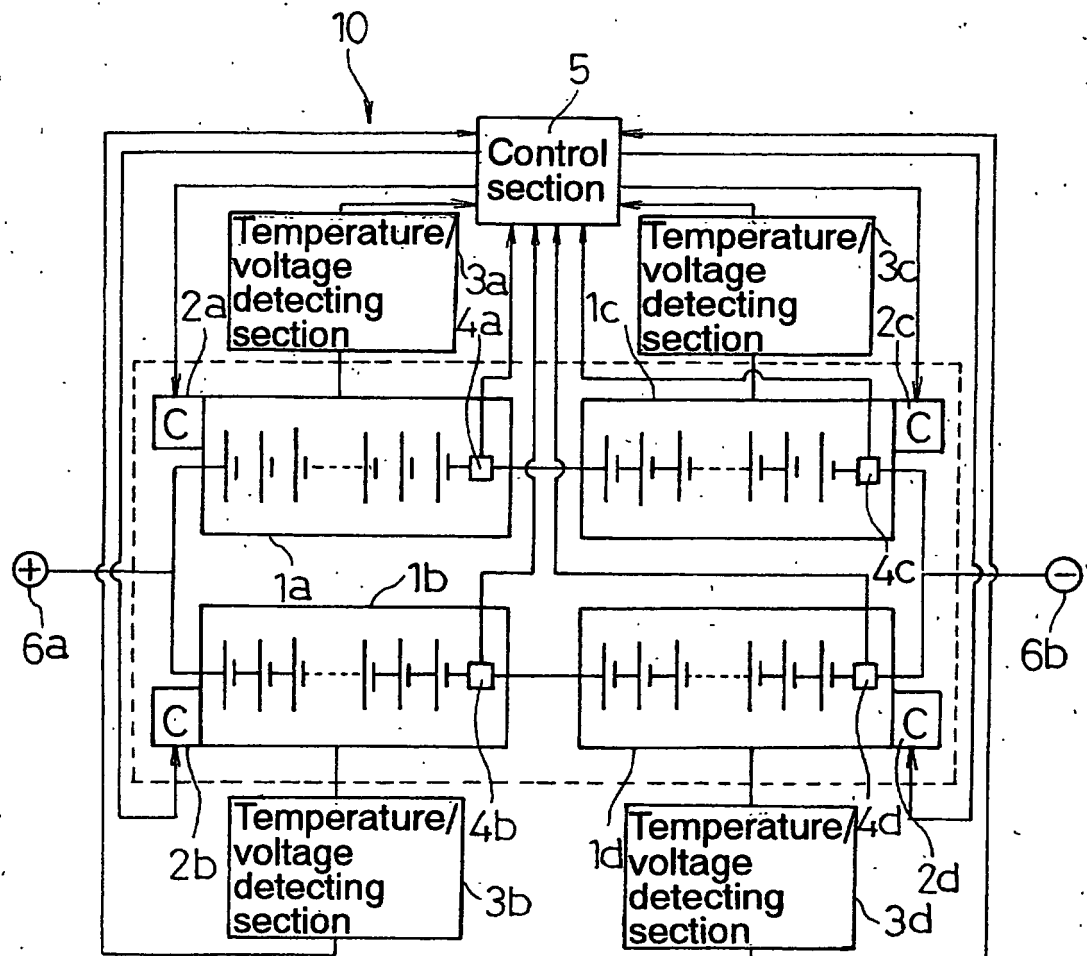
Fig. 1

Fig. 2A

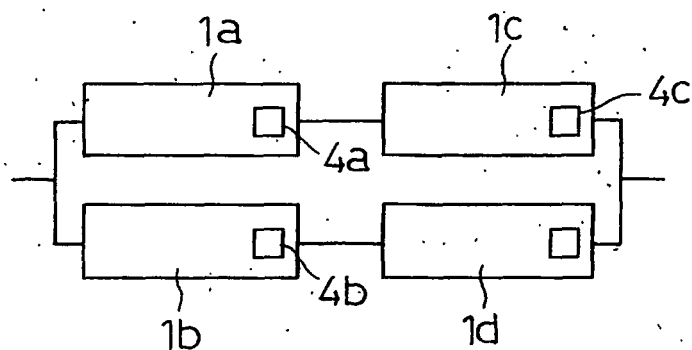


Fig. 2B

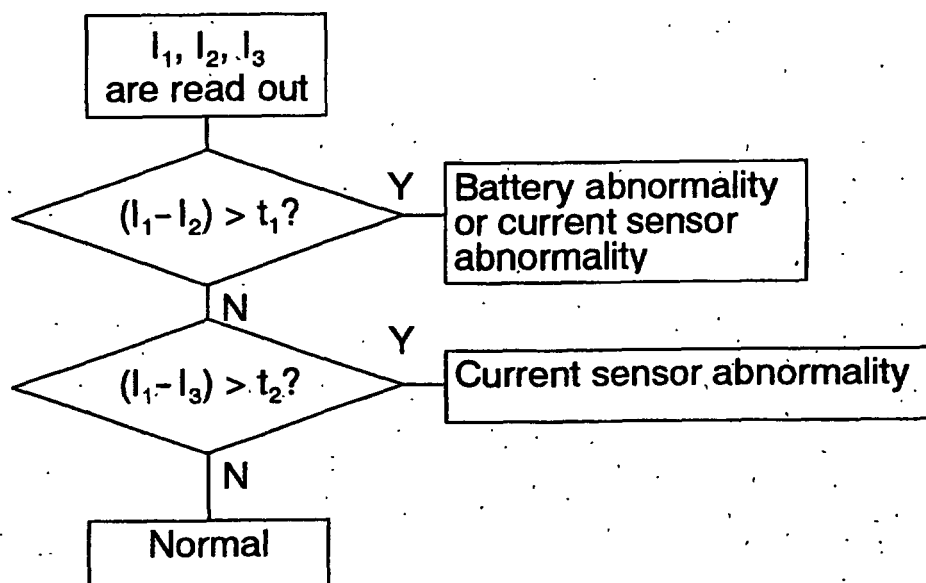


Fig. 3A

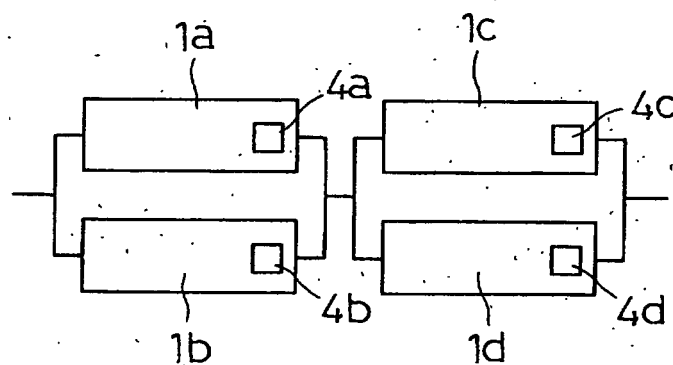


Fig. 3B

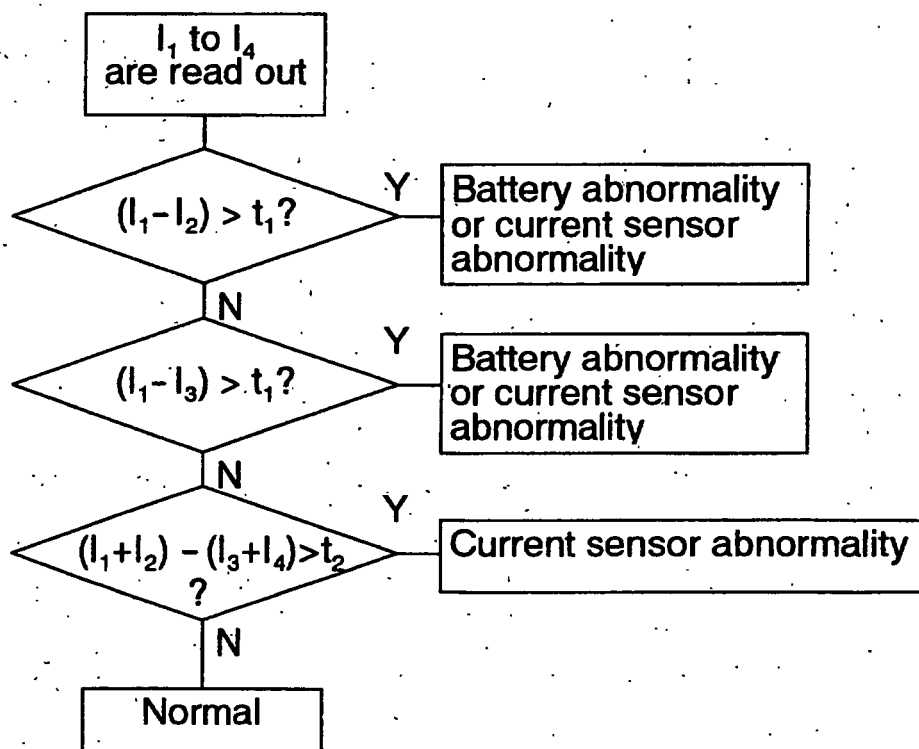
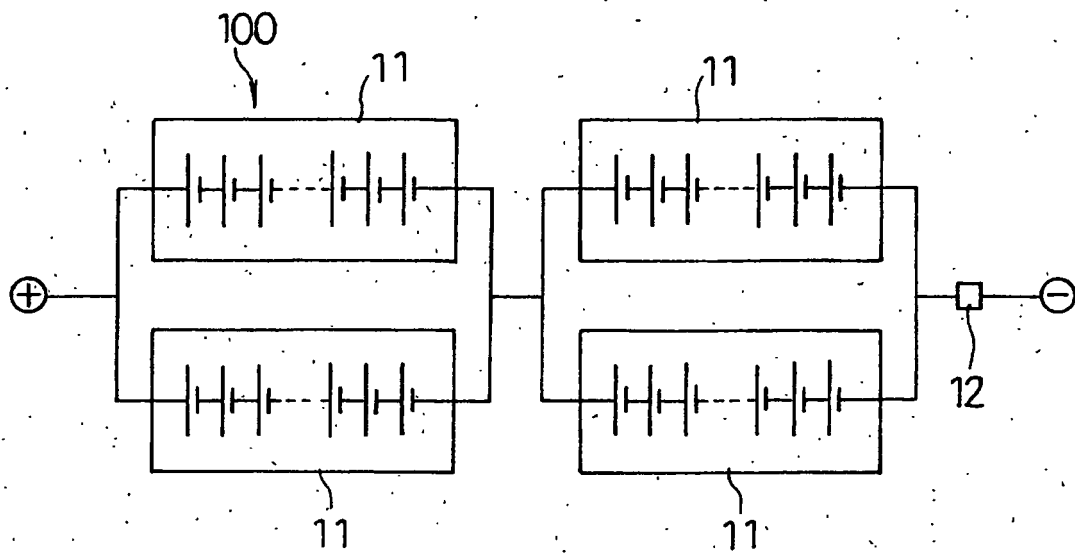


Fig. 4
Prior Art



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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